

Appl. No. 10/694,381
Amdt. dated June 2, 2005
Reply to Office Action of May 5, 2005

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

1. (original) A tire condition monitoring apparatus for monitoring the condition of a tire of a vehicle, the tire condition monitoring apparatus comprising;

a transmitter arranged in the tire;

a receiver for performing wireless communication with the transmitter;

a magnetic field generator arranged in the vehicle near the tire to generate a magnetic field; and

a magnetic field detector arranged in the transmitter to detect the magnetic field, wherein the transmitter determines rotation angle of the tire in accordance with the detection of the magnetic field detector to transmit data indicating the condition of the tire based on the rotation angle.

2. (currently amended) The tire condition monitoring apparatus according to claim 1, wherein:

the tire is one of a plurality of tires, the transmitter is one of a plurality of transmitters, each being arranged in one of the plurality of tires, and the magnetic field generator is one of a plurality of magnetic field generators, each being arranged in one of the plurality of tires;

the plurality of magnetic field generators are arranged so that each of the magnetic field detectors generates a magnetic field detection signal when the associated tire is rotating, the magnetic field detection signals having different waveforms or levels from each other;

each of the transmitters determines a mounting position of the associated tire based on the magnetic field detection signal received from the associated magnetic field detection device, each of the transmitters determines the rotation angle of the tire that is optimal for wireless communication in accordance with the mounting position of the associated tire, and each of the transmitters transmits data indicating the condition of the tire when the rotation angle of the associated tire is substantially the same as the optimum rotation angle.

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3. (original) The tire condition monitoring apparatus according to claim 2, wherein each of the magnetic field generators includes a plurality of magnetic field generating elements arranged in a wheel well of the vehicle, the magnetic field generating elements of one of the magnetic field generators being laid out differently from the magnetic field generating elements of the other magnetic field generators.

4. (original) The tire condition monitoring apparatus according to claim 2, wherein each of the transmitters includes:

a storage device for storing data of rotation angle ranges that are optimal for wireless communication in accordance with the mounting positions of the plurality of tires, and each of the transmitters determines the mounting position of the associated tire based on the magnetic field detection signal received from the associated magnetic field detection device, wherein each of the transmitters determines the optimum rotation angle of the tire of which mounting position has been determined from the data stored in the storage device, and wherein each of the transmitters transmits data indicating the condition of the associated tire when the rotation angle of the associated tire is in the optimum rotation angle range.

5. (original) The tire condition monitoring apparatus according to claim 1, wherein the transmitter includes a storage device for storing data of a rotation angle range that is optimal for wireless communication, the transmitter transmitting data indicating the condition of the tire when the detected rotation angle of the tire is in said rotation angle range.

6. (original) The tire condition monitoring apparatus according to claim 5, wherein the storage device is re-writable.

7. (original) The tire condition monitoring apparatus according to claim 5, wherein the magnetic field detector is a coil sensor or a semiconductor sensor.

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8. (original) The tire condition monitoring apparatus according to claim 1, wherein the magnetic field generator includes a permanent magnet.

9. (original) The tire monitoring apparatus according to claim 1, wherein the magnetic field detector includes an electromagnet.

10. (original) The tire condition monitoring apparatus according to claim 1, further including an informing device connected to the receiver to inform a passenger of the vehicle of the condition of the tire.

11. (original) The tire condition monitoring apparatus according to claim 1, wherein the receiver includes a receiving antenna for receiving a wireless signal of the transmitter, and the transmitter generates a wireless radio wave for generating induction voltage in the receiving antenna, transmits data indicating the condition of the tire when the rotation angle of the tire is not in a range in which the induction voltage becomes less than a minimum detectable voltage of the receiver.

12. (original) A tire condition monitoring apparatus for monitoring the condition of a plurality of tires, each accommodated in one of a plurality of wheel wells of a vehicle, the tire condition monitoring apparatus comprising;

a transmitter arranged in each tire to generate a wireless radio wave;

a receiver arranged in the vehicle to perform wireless communication with each transmitter, the receiver including a receiving antenna for receiving the wireless radio wave of each transmitter, and the wireless radio wave causing an induction voltage to be generated in the receiving antenna;

a plurality of permanent magnets fixed at a plurality of positions in each wheel well; and

a magnetic field detector arranged in each transmitter for detecting a magnetic field that acts on the transmitter;

wherein each transmitter detects the rotation angle of the associated tire in accordance with the detection of the associated magnetic field detector, and each transmitter transmits data

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indicating the condition of the tire when the rotation angle of the tire is in a predetermined range that is not in a range in which the induction voltage becomes less than a minimum detectable voltage of the receiver.

13. (original) The tire condition monitoring apparatus according to claim 12, wherein the plurality of wheel wells includes a first wheel well and a second wheel well, the permanent magnets of the first wheel well being laid out differently from the permanent magnets of the second wheel well.

14. (original) The tire condition monitoring apparatus according to claim 13, wherein the number of the permanent magnets in the first wheel well is the same as the number of permanent magnets in the second wheel well.

15. (original) The tire condition monitoring apparatus according to claim 14, wherein the permanent magnets of the first wheel well are arranged at first angular intervals, and the permanent magnets of the second wheel well are arranged at second angular intervals.

16. (original) A method for monitoring a tire condition in a vehicle including a tire mounted in a wheel well, the method comprising:

arranging a transmitter in the tire to generate a wireless radio wave;

arranging a receiver in a vehicle for performing wireless communication with the transmitter, with the receiver including a receiving antenna for receiving the wireless radio wave of the transmitter by the wireless radio wave causing an induction voltage to be generated in the receiving antenna;

fixing a plurality of permanent magnets at a plurality of positions in the wheel well;

arranging a magnetic field detector in the transmitter for detecting a magnetic field that acts on the transmitter;

determining the rotation angle of the tire at which the induction voltage becomes less than a minimum detectable voltage of the receiver;

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detecting the rotation angle of the tire in accordance with the detection of the magnetic field detector;

transmitting data indicating the condition of the tire when the rotation angle of the tire is in a predetermined range that excludes the determined rotation angle; and

receiving the data and displaying the condition of the tire in accordance with the received data.

17. (original) An apparatus for monitoring the condition of a tire mounted in a wheel well of a vehicle, the apparatus comprising:

a plurality of permanent magnets fixed to the wheel well;

a transmitter fixed to the tire and including a pressure sensor for detecting the air pressure of the tire, a magnetic impedance sensor for detecting electric fields generated by the plurality of permanent magnets, and a transmitter controller for determining rotation angle of the tire based on the detection of the magnetic impedance sensor and for transmitting air pressure data generated by the pressure sensor when the rotation angle of the tire is in a range optimal for wireless communication; and

a receiver arranged in the vehicle to receive the air pressure data.